

## WISSENSCHAFTLICHE KURZMITTEILUNGEN

### Summer diets of Tibetan Red foxes in Khunjerab National Park, Pakistan

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*Receipt of Ms. 05. 07. 1994  
Acceptance of Ms. 14. 11. 1994*

Food habits of terrestrial predators in the mountains of northern Pakistan have received relatively little quantitative attention (SCHALLER 1972, 1976, 1977). Khunjerab National Park is Pakistan's second largest national park (2,269 km<sup>2</sup>) and is located in the extreme northeastern corner of Pakistan. Tibetan red foxes (*Vulpes vulpes montana*) are the region's most common mammalian predator (HESS 1995). The purpose of this investigation was to study the diet of red foxes to aid in the effective conservation, management, and human coexistence with foxes and other wildlife in the Khunjerab region.

Our research had three broad goals. First to collect information on fox diets in a little studied location that would be useful in intraspecific studies (IRIARTE et al. 1990). Second, to determine the frequency with which domestic animals were found in the scats of Khunjerab foxes. Third, to study the consistency of food items between seasons and years.

The 250 ha study area (36°81' N, 74°95' E) included an uninhabited high alpine meadow (Dhee Sar) and its surrounding ridges and valleys (elevation 3 500 m–4 500 m) in Khunjerab National Park, Pakistan. The study site was a fairly representative high pasture in Khunjerab; uninhabited yet seasonally grazed between mid-May and late June by several hundred domestic cattle, yaks, goats, and sheep (BLUMSTEIN 1995).

Red fox scats were collected opportunistically from 15 May to 15 September 1990, and again from 4 May to 18 August 1991 in and around Dhee Sar. After collection, scats were air dried and placed in plastic bags labeled with date and location. Fox scats were unambiguously identified by size and shape. An unknown number of foxes were present in 1990, while  $\geq 10$  different foxes were seen at Dhee Sar during 1991.

In the laboratory, scats were broken apart and contents sorted. Hairs were washed in 100% ethyl alcohol, air dried, mounted on glass slides using Permount, and all were identified by a single observer (M. R.). Sample hairs were compared with known reference hairs, mostly from Dhee Sar, but some from museum collections. Hairs were identified according to characteristics commonly described in guides to hair analysis (e. g., RYDER 1973).

Domestic goats and sheep, as well as wild ibex, marmots, and pikas could be unambiguously identified by their hair. Hares, voles, and mice had less distinctive hair characteristics, but could generally be distinguished by their cortex width, and distinctive medullary characteristics. Hair from domestic cattle and yak were generally distinguishable. Bones or feathers were identified when possible. M. R.'s intraobserver reliability in identifying hair samples was high; 86% of identified scat contents were consistently re-identified on a second appraisal.

Relative frequencies of occurrence (occurrences in different scats as a function of total number of scats) of prey items are reported. Domestic cattle and yak were combined

for analysis and their joint frequency is reported. Early season versus late season frequencies were calculated by summing those items identified in scats collected in May and June and comparing frequencies with those scats collected in July and August.

Hair from nine mammalian species was identified in 177 fox scats (Tab. 1). Many scats contained multiple types of foods, so frequencies sum to  $> 1.0$ .

Marmot hair was 2.5 times more common in fox scats collected at Dhee Sar (overall frequency = 0.32,  $n = 177$  scats) than has been previously reported in areas with sympatric marmots (frequency = 0.13,  $n = 92$  scats; SCHALLER et al. 1987). In addition, livestock hair occurred 4.5 times more frequently in fox scats collected at Dhee Sar (combined overall relative frequency = 0.50,  $n = 177$  scats) than has been previously reported in the diets of Central Asian red foxes (weighted mean frequency = 0.11,  $n = 205$  scats; SCHALLER 1977; SCHALLER et al. 1987). Plant material was about as common in the diets of Dhee Sar foxes (overall relative frequency = 0.36,  $n = 177$  scats) as in other Central Asian red foxes (weighted mean frequency = 0.32,  $n = 274$  scats; SCHALLER 1977; SCHALLER et al. 1987).

In the two years of our study, fox diets varied considerably both between seasons and between years. Pikas, marmots, voles, eggshells, and plant material were identified in relatively constant frequencies in early season and late season scats. Voles and eggshells were identified in relatively constant frequencies between years. All other food items appeared to vary seasonally and annually.

Foxes are reported to have opportunistic and catholic food habits (e.g., LLOYD 1980). In other places, mid-sized mammals such as lagomorphs and marmots are eaten by sympatric foxes (e.g., SCHALLER 1977, VON SCHANTZ 1980; HEWSON 1983; SCHALLER et al.

**Table 1.** Relative frequency of occurrence of food items in Tibetan red fox scats collected in 1990 and 1991 at Dhee Sar, Khunjerab National Park, Pakistan

Food Items	1990	1991	1990 and 1991 <sup>1</sup>	M/J <sup>2</sup>	J/A <sup>3</sup>
Sample Size (no. of scats)	35	142	177	90	82
Wild Mammals					
<i>Lepus capensis tibetanus</i>	0.17	0.09	0.11	0.13	0.07
<i>Ochotona roylei</i>	0.11	0.01	0.03	0.02	0.05
<i>Marmota caudata aurea</i>	0.26	0.34	0.32	0.33	0.30
<i>Apodemus sylvaticus</i>	0.14	0.26	0.24	0.33	0.15
<i>Alticola roylei</i>	0.29	0.27	0.27	0.27	0.28
<i>Capra ibex sibirica</i>	0.09	0.01	0.03	0.06	0.00
Domestic Mammals					
<i>Bos</i> spp.	0.23	0.30	0.29	0.26	0.33
<i>Ovis</i> sp.	0.06	0.15	0.14	0.21	0.06
<i>Capra</i> sp.	0.00	0.08	0.07	0.08	0.06
Miscellaneous					
Feathers <sup>4</sup>	0.09	0.17	0.15	0.21	0.07
Eggshell	0.06	0.04	0.04	0.06	0.02
Plant material <sup>5</sup>	0.23	0.39	0.36	0.34	0.38

<sup>1</sup> Overall relative frequency of occurrence of food items in both years.

<sup>2</sup> May and June relative frequency of occurrence of food items in both years.

<sup>3</sup> July and August relative frequency of occurrence of food items in both years.

<sup>4</sup> Identified feathers included: 1 Redstart (*Phoenicurus* sp.), 2 Brown Accentors (*Prunella fulvescens*), 2 Rosy Finches (*Leucosticte* spp.), 2 Choughs (*Pyrrhocorax* spp.), and 4 Himalayan Snowcocks (*Tetraoedus himalayensis*).

<sup>5</sup> Included both vegetative remains of grasses and other herbaceous plants as well as remains of the fruit of *Ephedra Gerardiana* and *Rosa webbiana*.

1987). Marmots were more common at Dhee Sar than hares and this was reflected in the diets of Khunjerab foxes. Observations suggest that both juvenile and adult marmots fell prey to foxes at Dhee Sar. In 1990 and 1991, D. T. B. observed foxes eating 2 recently killed adult marmots. Foxes were more frequently seen after marmot pups emerged (late June, early July), and at least 19% of marmot pups were probably killed by predators.

Plant material was commonly found in fox scats. ROBERTS (1977) reported that the red fox can subsist on fruit and insects, and plant remains have been reported to be a major component of fox diets elsewhere (GREEN and OSBORNE 1981; CALISTI et al. 1990). Outside the study site, but within the national park, fox scats seen in the fall were often filled with *Ephedra* berries, suggesting that foxes were eating plants and plant parts rather than incidentally ingesting them.

### Acknowledgements

D. T. B. thanks the government of Pakistan and the Khunjerab Village Organization for permission to work in Khunjerab and for hospitality while in Pakistan. We thank N. U. BAIG, M. K. SHAH, A. A. JAIN, T. ERWIN, and participants from the University Research Expeditions Program for assistance collecting and analyzing scats; B. D. PATTERSON (Field Museum of Natural History) and T. RANA (Pakistan Museum of Natural History) for reference hairs; and R. K. GROSBURG for use of his photomicrograph equipment. BLUMSTEIN's research in Khunjerab has been generously supported by the National Geographic Society, the University of California, Davis, University Research Expeditions Program, the American Society of Mammalogists, Sigma Xi, The Explorers Club, the U.S. National Park Service International Division, the World Pheasant Association-Pakistan, World Wide Fund for Nature-Pakistan, The North Face, Hi-Tec Sports, and Bushnell of America. Finally, we thank D. VAN VUREN, R. E. MIRARCHI, S. R. HUMPHREY, and B. H. BLAKE for their helpful comments on previous versions of this paper.

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